US00RE37853E

(19) **United States**

(12) **Reissued Patent**

Detering et al.

(10) **Patent Number: US RE37,853 E**

(45) **Date of Reissued Patent: Sep. 24, 2002**

(54) **FAST QUENCH REACTOR AND METHOD**

(75) Inventors: **Brent A. Detering; Alan D. Donaldson; James R. Fincke; Peter C. Kong**, all of Idaho Falls, ID (US)

(73) Assignee: **Betchel BWXT Idaho, LLC**, Idaho Falls, ID (US)

(21) Appl. No.: **09/569,146**

(22) Filed: **May 11, 2000**

Related U.S. Patent Documents

Reissue of:

(64) Patent No.: **5,749,937**
Issued: **May 12, 1998**
Appl. No.: **08/404,395**
Filed: **Mar. 14, 1995**

(51) **Int. Cl.**[7] **C22B 4/06**; C22B 4/08

(52) **U.S. Cl.** **75/10.19**; 75/10.21; 75/10.28; 75/346; 266/182; 373/18; 420/590; 422/207; 423/289; 423/613; 585/538

(58) **Field of Search** 75/10.19, 10.21, 75/10.28, 346, 620; 266/182; 219/121.36; 373/18; 420/590; 423/289, 613; 422/207; 585/538, 539

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,051,639	A	* 8/1962	Anderson	585/539
3,211,548	A	10/1965	Scheller et al.	75/84
3,429,691	A	2/1969	McLaughlin	75/10
3,630,718	A	12/1971	Newenschwander	75/0.5
3,738,824	A	6/1973	Davis et al.	75/0.5 B
3,840,750	A	10/1974	Davis et al.	250/547
3,914,573	A	10/1975	Muehlberger	219/76
3,954,954	A	5/1976	Davis et al.	423/492
4,022,872	A	5/1977	Carson et al.	423/297
4,080,194	A	3/1978	Fey	75/10 R
4,107,445	A	8/1978	Wolf et al.	13/2 P
4,145,403	A	* 3/1979	Fey et al.	423/613
4,164,553	A	8/1979	Perugini et al.	423/440
4,335,080	A	6/1982	Davis et al.	422/244
4,347,060	A	8/1982	Blizzard et al.	23/294 R
4,356,029	A	10/1982	Down et al.	75/0.5 B
4,410,358	A	10/1983	Heshmatpour	75/10 R
4,561,883	A	* 12/1985	Mullner et al.	75/10.19
4,610,718	A	9/1986	Araya et al.	75/0.5 C
4,731,111	A	3/1988	Kopatz et al.	75/0.5 AB
4,762,756	A	8/1988	Bergmann et al.	428/698
4,772,315	A	9/1988	Johnson et al.	75/0.5 AA
4,783,216	A	11/1988	Kemp et al.	75/0.5 BB
4,801,435	A	1/1989	Jozef	422/186.04
4,875,810	A	10/1989	Chiba et al.	406/14
4,891,066	A	1/1990	Shimotori et al.	75/84
4,909,914	A	3/1990	Chiba et al.	204/164
4,911,805	A	3/1990	Kenji et al.	204/164
5,017,754	A	5/1991	Drouet et al.	219/121.36
5,028,417	A	7/1991	Gulguhji et al.	424/59
5,062,936	A	11/1991	Beaty et al.	204/164
5,073,193	A	* 12/1991	Chaklader et al.	75/346
5,194,128	A	3/1993	Beaty et al.	204/164
5,215,749	A	* 6/1993	Nicoll et al.	424/401
5,257,500	A	11/1993	Kattalaicheri et al.	60/39.821
5,294,242	A	3/1994	Zurecki et al.	75/345
5,935,293	A	* 8/1999	Detering et al.	75/10.19

OTHER PUBLICATIONS

Down, M. G., *Titanium Production by a Plasma Process*, Final Technical Report, Materials Laboratory, Air Force Wright Aeronautical Laboratories (#AD A 121892) May 1982, pp. 1–8.

"The INEL Plasma Research Program", Idaho National Engineering Laboratory (BP422E–R0592–1M–T), May 1992.

* cited by examiner

Primary Examiner—Melvyn Andrews

(74) *Attorney, Agent, or Firm*—Workman Nydegger & Seeley

(57) **ABSTRACT**

A fast quench reaction includes a reactor chamber having a high temperature heating means such as a plasma torch at its inlet and a restrictive convergent-divergent nozzle at its outlet end. Reactants are injected into the reactor chamber. The resulting heated gaseous stream is then rapidly cooled by passage through the nozzle. This "freezes" the desired end product(s) in the heated equilibrium reaction stage.

70 Claims, 7 Drawing Sheets